

That which is claimed:

1. A gamma ray detector assembly for placement in a logging tool in a borehole, the detector assembly comprising:

a first gamma ray detector elongated along an axis and defining a void extending along the axis; and

a second gamma ray detector conforming to at least a portion of the void, wherein the first and second gamma ray detectors are configured to be positioned in the borehole.

2. The detector assembly of Claim 1, further comprising a substantially waterproof housing enclosing the first gamma ray detector and the second gamma ray detector.

3. The detector assembly of Claim 1, wherein the first gamma ray detector and the second gamma ray detector are scintillation detectors.

4. The detector assembly of Claim 1, wherein the first and second gamma ray detectors are cylindrical, the first gamma ray detector forms an outer cylinder and the second gamma ray detector forms an inner cylinder.

5. The detector assembly of Claim 1, wherein the first gamma ray detector has a variable thickness around the perimeter of the second gamma ray detector.

6. The detector assembly of Claim 1, further comprising a shielding material on an end of the first gamma ray detector and a radioactive neutron source on a side of the shielding material facing away from the first gamma ray detector, wherein the radioactive source is configured to irradiate material in the borehole.

7. The detector assembly of Claim 3, further comprising a first photomultiplier tube in communication with the first gamma ray detector and a second photomultiplier tube in communication with the second gamma ray

detector.

8. The detector assembly of Claim 1, further comprising a signal processor configured to receive signals from the first and second gamma ray detectors.

9. The detector assembly of Claim 8, wherein the signal processor is configured to detect a first event in one of the first gamma ray detector and the second gamma ray detectors and to determine if a second event is detected in coincidence with the first event in the other of the first and the second gamma ray detectors.

10. The detector assembly of Claim 8, wherein the signal processor is configured to determine the rate of coincidence between an event in one of the first and second gamma ray detectors and an annihilation photon in the other of the first and second gamma ray detectors.

11. The detector assembly of Claim 8, wherein the signal processor is configured to determine the rate of coincidence between an event and two annihilation photons.

12. The detector assembly of Claim 8, wherein the signal processor is configured to determine the rate of coincidence between a first event and a second event, wherein the first event and the second event sum to a predetermined energy.

13. The detector assembly of Claim 12, wherein the predetermined energy is between about 1.5 MeV and 11 MeV.

14. The detector assembly of Claim 8, wherein the signal processor is further configured to determine a ratio of oxygen and carbon based on events in the first and second gamma ray detectors.

15. A method of detecting gamma rays in a borehole, the method

comprising:

placing a first gamma ray detector and a second gamma ray detector into the borehole, wherein the first gamma ray detector is elongated along an axis and defines a void extending along the axis and the second gamma ray detector conforms to at least a portion of the void;

detecting a first event in one of the first gamma ray detector and the second gamma ray detector; and

determining whether a second event is detected in coincidence with the first event in the other of the first gamma ray detector and the second gamma ray detector.

16. The method of Claim 15, wherein the first and second gamma ray detectors are cylindrical, wherein the first gamma ray detector forms an outer cylinder and the second gamma ray detector forms an inner cylinder.

17. The method of Claim 15, wherein the first gamma ray detector has a thickness that varies around the perimeter of the second gamma ray detector.

18. The method of Claim 15, further comprising: positioning a shielding material on an end of the first gamma ray detector; and positioning a radioactive source on a side of the shielding material facing away from the first gamma ray detector; and irradiating material in the borehole with the radioactive source.

19. The method of Claim 15, further comprising providing a first photomultiplier tube in communication with the first gamma ray detector and a second photomultiplier tube in communication with the second gamma ray detector.

20. The method of Claim 15, wherein determining whether a second event is detected in coincidence with the first event includes determining a rate of coincidence between an event in one of the first and second gamma ray detectors and an annihilation photon in the other of the first and second gamma ray detectors.

21. The method of Claim 15, wherein determining whether a second event is detected in coincidence with the first event includes determining the rate of coincidence between an event and two annihilation photons.

22. The method of Claim 15, wherein determining whether a second event is detected in coincidence with the first event includes determining the rate of coincidence between a first event and a second event, wherein the first event and the second event sum to a predetermined energy.

23. The method of Claim 22, wherein the predetermined energy is between about 1.5 MeV and about 11 MeV.

24. The method of Claim 15, further comprising determining a ratio of oxygen and carbon based on events in the first and second gamma ray detectors.

25. A method of detecting gamma rays in a borehole comprising:
placing a first gamma ray detector and a second gamma ray detector into the borehole;

detecting a first event in one of the first gamma ray detector and the second gamma ray detectors; and

determining whether a second event is detected in coincidence with the first event in the other of the first gamma ray detector and the second gamma ray detectors.